

## CLAIMS

1. A cooling mechanism for a rotary valve cylinder engine comprising a rotary valve cylinder rotatably mounted within an outer cylindrical valve element, the rotary valve cylinder and the outer cylindrical valve element each being formed with a respective valve port, the rotary valve cylinder being rotatable relative to the outer cylindrical valve element to a position in which the ports are aligned, the cooling mechanism comprising at least one passage formed in the rotary valve cylinder through which, in use, cooling fluid flows.
2. A cooling mechanism according to claim 1 wherein the rotary valve cylinder comprises a cylindrical cylinder wall in which the fluid cooling passage is formed.
3. A cooling mechanism according to claim 1 or 2, wherein the fluid cooling passage in the rotary cylinder wall extends substantially along the length of the rotary cylinder wall.
4. A cooling mechanism according to claim 1, 2 or 3, wherein the fluid cooling passage extends in a direction substantially parallel to the rotational axis of the rotary valve cylinder.
5. A cooling mechanism according to any one of claims 1 to 4, wherein the rotary valve cylinder is formed with a plurality of fluid cooling passages.
6. A cooling mechanism according to any one of claims 1 to 5, wherein the fluid cooling passages, when viewed in the direction of the axis of rotation of the rotary valve cylinder, extend substantially around the circumference of the rotary valve cylinder wall.
7. A cooling mechanism according to claim 5 or 6, wherein the fluid cooling passages in the rotary cylinder are substantially equispaced around the circumference of the rotary cylinder.

8. A cooling mechanism according to any one of claims 1 to 7, wherein the fluid cooling passage or passages are defined between an inner cylinder which is received within an outer cylinder to together define the rotary valve cylinder, at least one of the inner or outer cylinders being formed with a groove or grooves which define(s) the oil cooling passage or passages.

9. A cooling mechanism according to any one of the preceding claims, wherein the fluid flow path includes passageways formed within the outer cylindrical valve element.

10. A cooling mechanism according to any one of the preceding claims, wherein the rotary valve cylinder comprises a circular top surface which closes one end of the rotary valve cylinder to define a combustion chamber between the underside of the top surface and the top of a piston located inside the rotary valve cylinder, the cooling fluid being forced over the circular top surface of the rotary valve cylinder to cool the circular top surface of the rotary valve cylinder.

11. A cooling mechanism according to claim 10, wherein an upper part of the rotary valve cylinder is formed with at least one channel or channels around the periphery of the circular top surface through which, in use, the cooling fluid flows.

12. A cooling mechanism according to claim 10 or 11, wherein an upper fluid cooling chamber is formed adjacent the circular top surface of the rotary valve cylinder.

13. A cooling mechanism according to claim 12, wherein the fluid cooling passage or passages in the wall of the rotary valve cylinder communicate with the upper fluid cooling chamber via the channel or channels formed in the upper part of the rotary valve cylinder.

14. A cooling mechanism according to claim 12 or 13, wherein the fluid cooling passage or passages in the wall of the rotary valve cylinder communicate with the upper fluid cooling chamber at the periphery of the upper fluid cooling chamber.

15. A cooling mechanism according to any one of the preceding claims, wherein, in use, the cooling fluid enters the rotary cylinder at an upper end of the rotary valve cylinder at a position adjacent the top surface of the rotary valve cylinder.

16. A cooling mechanism according to the cooling fluid exits from a lower end of the rotary valve cylinder at a position distal from the circular top surface of the rotary valve cylinder.

17. A cooling mechanism according to any one of claims 11 to 16, wherein the fluid enters the rotary valve cylinder at a feed point at the top surface of the rotary valve cylinder, a fluid seal being provided immediately below the fluid feed point, the fluid seal, in use, resisting any fluid flow from the fluid feed point into the region of the valve port of the rotary valve cylinder.

18. A cooling mechanism according to claim 17, wherein the fluid enters the top surface of the rotary valve cylinder through a channel formed in a boss that is of smaller diameter than the outer diameter of the rotary valve cylinder.

19. A cooling mechanism according to claim 18, wherein the upper fluid cooling chamber is positioned between the boss and the top surface of the rotary valve cylinder so that the fluid flows down through the channel formed in the boss so as to flow within the inner diameter of the fluid seal, and into the upper fluid cooling chamber.

20. A cooling mechanism according to according to any one of claims 12 to 19, wherein the upper fluid cooling chamber is formed by a substantially hollow plug at the top surface of the rotary valve cylinder, the periphery of the plug being sealed against the periphery of the top surface of the rotary valve cylinder, the fluid cooling chamber being defined between the walls and ceiling of the plug and the top surface of the rotary valve cylinder.

21. A cooling mechanism according to any one of claims 12 to 20, wherein, in use, the fluid flows through the upper fluid cooling chamber so as to directly contact the top

surface of the rotary valve cylinder to provide direct cooling of the top surface of the rotary valve cylinder, which in turn cools the combustion chamber roof.

22. A cooling mechanism according to any one of the preceding claims, wherein the outer cylindrical valve element is provided with cooling means operative to transfer thermal energy from the fluid to the outer cylindrical valve element and into the air surrounding the second cylindrical valve element.

23. A cooling mechanism according to claim 22, wherein the cooling means comprises at least one fin extending outwardly from the outer cylindrical valve element.

24. A cooling mechanism according to claim 23, wherein the cooling means comprises a plurality of fins that are relatively spaced around at least part of the outer cylindrical valve element.

25. A cooling mechanism according to any one of claims 22 to 24 when dependent on claim 9, wherein the fluid passageways formed in the outer cylindrical valve element are adjacent the cooling means to maximise the transfer of thermal energy from the fluid to the outer cylindrical valve element and to the air surrounding the outer cylindrical valve element.

26. A cooling mechanism according to claim 25, wherein the fluid passageways formed in the outer cylindrical valve element are substantially equispaced around the outer cylindrical valve element.

27. A cooling mechanism according to any one of claims 1 to 21, wherein the outer cylindrical valve element is provided with cooling means operative to transfer thermal energy from the fluid to a liquid cooling medium contained in a jacket formed in the outer cylindrical valve element.

28. A cooling mechanism according to claim 27, wherein the jacket is adjacent the fluid passageways formed in the outer cylindrical valve element.

29. A cooling mechanism according to claims 27 or 28, wherein the liquid cooling medium is a water based cooling medium.
30. A cooling mechanism according to any one of the preceding claims, wherein the fluid cooling medium is oil.
31. A cooling mechanism according to claim 30, wherein the oil is the engine lubrication oil.
32. A cooling mechanism for a rotary valve cylinder engine comprising a rotary valve cylinder rotatably mounted within an outer cylindrical valve element, the rotary valve cylinder and the outer cylindrical valve element each being formed with a respective valve port, the rotary valve cylinder being rotatable relative to the outer cylindrical valve element to a position in which the ports are aligned, the cooling mechanism comprising a heat sink mounted directly to an upper part of the rotary valve cylinder so as to rotate with the rotary valve cylinder, the heat sink being otherwise exposed to the open air.
33. A cooling mechanism according to claim 32, wherein the heat sink comprises a separate component mounted directly to the top of the rotary valve cylinder.
34. A cooling mechanism according to claim 32, wherein the heat sink is formed integrally with the rotary valve cylinder so that the heat sink and rotary valve cylinder together comprise a single component.
35. A cooling mechanism according to claim 32, 33 or 34, wherein the upper part of the rotary valve cylinder comprises a circular top surface below which is provided a combustion chamber.
36. A cooling mechanism according to claim 35, wherein to maximise the heat transferred to the heat sink, the diameter of the part of the circular top surface of the rotary valve cylinder to which the heat sink is attached is at least 50% of the external diameter of the rotary valve cylinder.

37. A cooling mechanism according to claim 35 or 36, wherein the base of the heat sink is at least 50% of the external diameter of the rotary valve cylinder.

38. A cooling mechanism according to claim 36 or 37, wherein to maximise the heat transferred to the heat sink, the diameter of the part of the top surface of the rotary valve cylinder to which the heat sink is attached is at least 75% of the external diameter of the rotary valve cylinder.

39. A cooling mechanism according to claim 32 to 38, wherein the rotary valve cylinder is mounted on the outer cylindrical valve element by bearing means, the bearing means being positioned distal from the upper part of the rotary valve cylinder so that the valve port formed in the rotary valve cylinder is between the upper part and the bearing means.

40. A cooling mechanism according to claim 39, wherein the bearing means comprises two relatively spaced bearings.

41. A cooling mechanism according to claim 40 wherein one of the two bearings is located below but adjacent the valve port of the rotary valve cylinder, whilst the other bearing is located at a lower part of the rotary valve cylinder distal from the valve port of the rotary valve cylinder.

42. A cooling mechanism for a rotary valve cylinder engine comprising a rotary valve cylinder rotatably mounted within an outer cylindrical valve element, the rotary valve cylinder and the outer cylindrical valve element each being formed with a respective valve port, the rotary valve cylinder being rotatable relative to the outer cylindrical valve element to a position in which the ports are aligned, the cooling mechanism comprising thermal insulation means at an inner surface of the valve port formed on the outer cylindrical valve element, the thermal insulation means being operative to minimise the thermal energy transferred between the outer cylindrical valve element and any gas flowing through the port.

43. A cooling mechanism according to claim 42, wherein the valve port formed in the second cylindrical valve element comprises an inner surface, the thermal insulation means substantially covering the inner surface such that the gas flows against the thermal insulation means.

44. A cooling mechanism according to claim 42 or 43, wherein the inner surface of the valve port is of rectangular transverse cross section when viewed along the longitudinal axis of the valve port.

45. A cooling mechanism according to any one of claims 42 to 44, wherein a manifold is provided to convey gas to or from the valve port in the outer cylindrical valve element, the thermal insulation means comprising a protrusion on the inlet manifold which protrudes into the valve port towards the rotary valve cylinder.

46. A cooling mechanism according to claim 45, wherein the protrusion extends into the valve port towards the rotary valve cylinder so as to be adjacent but not in contact with the rotary valve cylinder.

47. A cooling mechanism according claim 45 or 46, wherein the protrusion is spaced from the inner surface of the valve port so that a small air gap is provided between the radially outer surface of the protrusion and the inner surface of the inlet port, the air providing further thermal insulation between fit gas and the outer cylindrical valve element.

48. A cooling mechanism according to claim 45, 46 or 47, wherein the manifold is mounted on the outer cylindrical valve element by mounting means formed from a thermally insulating material.

49. A cooling mechanism according to claim 42, 43 or 44, wherein the thermal insulation means is formed from a separate tubular component made from a thermally insulating material, said tubular component being adapted to be received in the valve port so as to substantially cover the inner surface of the valve port.

50. A cooling mechanism according to claim 49, wherein the outer cylindrical valve element is formed with an inlet valve port and an exhaust valve port, thermal insulation means being provided on both ports so as to reduce heat transfer from the outer cylindrical valve element to the inlet gas through the inlet valve port, and to reduce heat transfer from the exhaust gas to the outer cylindrical valve element through the exhaust port.

51. A cooling mechanism according to any one of claims 1 to 31, in combination with a cooling mechanism according to any one of claims 42 to 50.

52. A cooling mechanism according to any one of claims 32 to 41, in combination with a cooling mechanism according to any one of claims 42 to 50.